REVISION OF THE COMPOSITE SPECIES *LIMA BASSI* TENISON WOODS (MOLLUSCA, BIVALVIA)

by M. F. BUONAIUTO*

Summary

BUONAIUTO, M. F. (1977) Revision of the composite species *Lima bassi* Tennison Woods Mollusca, Bivalvia). *Trans. R. Soc. S. Aust.* **101**(3), 75-83, 31 May, 1977.

The composite species *Lima bassi* Tenison Woods is revised. Among the forms referred to *Lima bassi* (ranging from Late Eocene to Pliocene), four species are recognized: the Late Eocene *L. maslinensis* sp. nov., the Early Miocene *L. bassi* s. str., the Middle Miocene (Batesfordian) *L. morganensis* sp. nov., and the Late Pliocene *L. elianae*. A neotype and paraneotypes of *Lima bassi* from the type-locality are established.

Introduction

During the present revision of the Eocene Mollusca from the type section of the Aldingan stage, different species revealed themselves as composite: *Lima bassi* Tenison Woods is one of them. Past authors grouped at least three distinct forms in it: the Longfordian *Lima bassi*, the Late Eocene *L. maslinensis* sp. nov., the Batesfordian *L. morganensis* sp. nov., and a fourth Pliocene form *L. elianae* from Dry Creek Sands.

Apart from the revision of *Lima bassi* and the description of three new taxa, it is necessary to establish a neotype and paraneotypes of *L. bassi*. Since Ludbrook (1967) revised the Johnston and Wood's types, it is common knowledge that many of these types were lost during the first half of this century. The holotype of *Lima bassi* is one of them.

Although authors quote several localities, the only localities considered here are those from which the specimens examined were obtained.

Definitions of the parameters here measured (after Cox, Nuttall & Trueman, *in* Moore 1969).

Hl —height of valve distance between two planes, parallel to cardinal axis, perpendicular to commissure plane, and tangent to umbonal and ventral ends of valve.

Ll —length of valve as distance between 2 planes perpendicular to cardinal axis and tangent to anterior and posterior ends of valve.

Lpa—length of posterior auricle, as distance between two planes tangent to beak and to posterior end of auricle and normal to cardinal axis.

Laa—length of anterior auricle, analogously defined as the above parameters.

Lca—length of cardinal area as distance between two planes tangent to auricles' ends and perpendicular to cardinal axis.

Hr —height of resilifer as distance between two parallel planes, parallel to cardinal axis, and tangent to its upper and lower ends.

Lr —length of resilifer, as distance between two planes, perpendicular to cardinal axis, and tangent to its anterior and posterior ends.

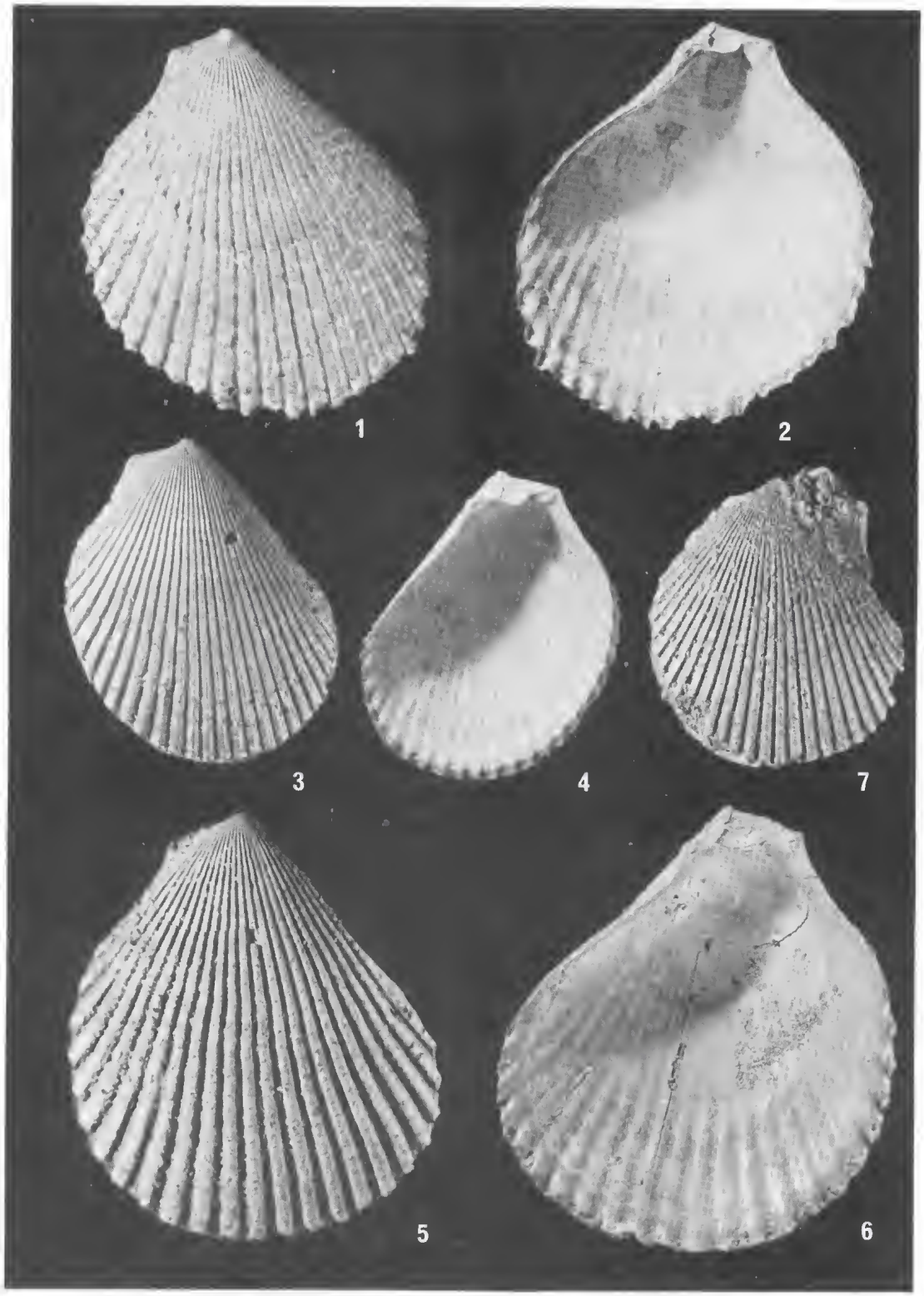
Ts —thickness of valve, as distance between two parallel planes: former tangent to commissure line, and latter tangent to outer valve surface.

Hca—height of cardinal area, as distance between two planes parallel to cardinal axis and tangent to its upper and lower ends.

Tca—distance between two parallel planes: former tangent to beak; latter tangent to commissure line.

Standard ratios were calculated. The ratio Tca/Ht = Tg$\hat{a}$ represents the tangent of the angle $\hat{a}$ between the geometric generating curve as defined by Raup (1966) after Stasek (1966) where the biological generating curve coincides with the growing edge of the valve, and the geometric generating curve is the intersection of the valve with a plane containing the coiling axis and tangent to the ventral end of the biological curve. The angle $\hat{a}$ determines the degree of maximum opening breadth between valves.

* Department of Geology and Mineralogy, University of Adelaide, North Tce, Adelaide, S. Aust. 5000.



FIGS 1–7

Collections. SAM: South Australian Museum. GSSA: Geological Survey of South Australia.

Systematic descriptions

CLASS: BIVALVIA Linné, 1758

SUBCLASS: PTERIOMORPHIA Beurlen, 1944

ORDER: PTERIOIDA Newell, 1965

SUBORDER: PTERIINA Newell, 1965

SUPERFAMILY: LIMACEA Rafinesque, 1815

FAMILY: LIMIDAE Rafinesque, 1815

GENUS: *Lima* Bruguière, 1797

SUBGENUS: *Lima* s.str.

Lima (Lima) bassi Tenison Woods, 1877

FIGS 1–2, 11–13, 17–24

1877 *Lima bassii* Tenison Woods, p. 112. 1886 *Lima bassi*—Tate, p. 117 (*pars*). 1955 *Lima bassi*—Ludbrook, p. 35 (*pars*).

Neotype: RV senile, figs 1–2 (SAM 18343/1).

Paraneotypes: 6 RV, 2 LV adults, figs 17–24, (SAM P18343/2–8).

Stratigraphic location: Freestone Cove Sandstone (Longfordian).

Type locality: Table Cape, Tasmania, Bass Basin (Freestone Cove).

Description: Shell rather thin, subtrigonal, very inequilateral, little inflated, higher than long; umbones with acute small prosogyrate beaks. Margins: antero- and postero-dorsal straight, the latter longer; anterior very long, concave; posterior very long, concave near the umbo, convex and very elliptical to the ventral; ventral very elliptical. Margin connections: antero-dorsal–anterior and posterodorsal–posterior very angular; anterior/ and posterior–ventral imperceptible. Auricles triangular, small, the anterior reduced. Longitudinal shell section regularly but weakly convex. Regions: posterior and dorsoventral convex and gently declivous; anterior convex and gently declivous to the dorsum, subconcave and vertical at the margin. Region connections: imperceptible; the two different parts of the anterior by a sharp rim.

Cardinal area narrow, triangular; resilifer broad, triangular, concave. Hinge taxodont with two small longitudinal teeth on the auricles. Interior radially ribbed; pallial line imperceptible; monomyarian with posterior adductor scar faint, rather high and marginal, 8-shaped, broader in the upper part. Commissure region crenulated except near the hinge.

Ornament: Prominent scaly radial ribs with equal U-shaped interspaces. Between the interspaces concentric flat microcostae; in juvenile–adult the anteriors and the posteriors convergent to the dorsoventral where they overlap with a shagreen pattern; in adult regularly concentric microcostae; in seniles very fine growth lines only.

Anterior marginal region concentric costae and weak radial ribs.

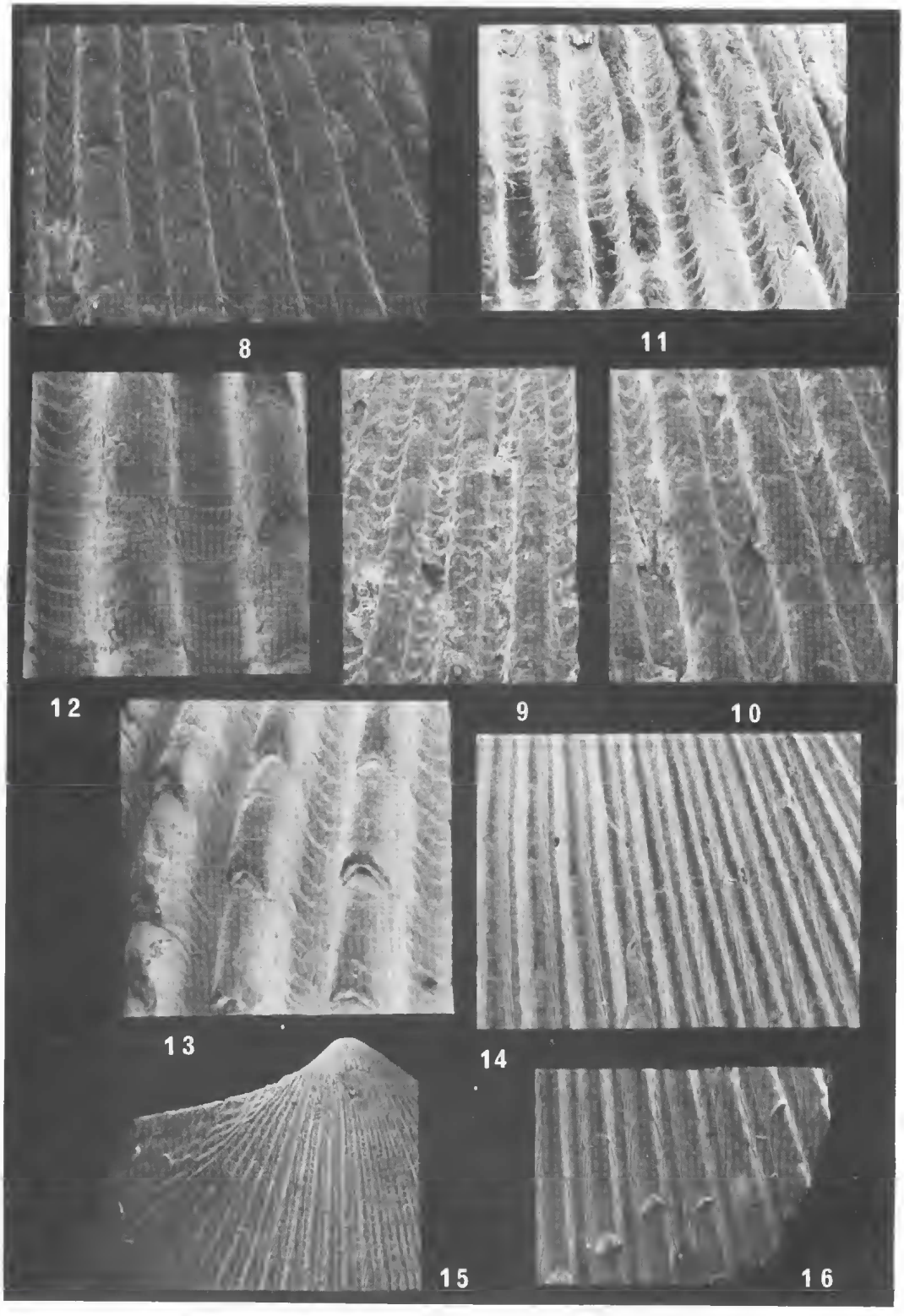
Auricles: anterior strong concentric costae; posterior with strong radial ribs.

Dimensions (mm): (see Table 1).

Observations: Tate commented on differences among specimens from Table Cape, Morgan, Aldinga and Adelaide. On the basis of concentric microornaments he distinguished from *L. bassi* s. str. a var. *A* for the specimens from Morgan, and a var. *B* for the specimens from Aldinga and Adelaide Bore. These varieties are here raised to species as *L. morganensis* and *L. maslinensis* respectively.

Paraneotype 2 displays in neanic-juvenile stages concentric microornament similar to that of *L. maslinensis*, abruptly passing to the regular concentric microornament. In adult senile stages secondary radial microriblets can develop in some interspaces. The other paraneotypes display variability in Ht/Lt ratio and in morphology (Figs 17–22). In reference to the type-locality, Johnston (1877) quoted a *Lima squamosa* in the "Crassatella Beds". Further, Johnston listed *L. bassi* = *L. squamosa* Lamarck. Banks (in Gill 1962) revised and redefined Johnston's "Crassatella Beds" as the Freestone Cove Sandstone, attributing to it a Late Oligocene age. Quilty (1966) and Ludbrook (1967, 1973) gave evidence of a Longfordian age for Table Cape Group of which the Freestone Cove Sandstone is part, on the basis of both benthonic and plantonic fora-

Figs 1-2. *Lima bassi*, neotype, Freestone Cove; Longfordian: (1) dorsal view; (2) interior view (x1.15). Figs 3-4. *L. morganensis* sp. nov., Batesfordian; (3) holotype (GSSA M 3138), near Morgan, dorsal view (x2.2); (4) paratype (SAM T982 E), Murray Cliffs, interior view (x2.55). Figs 5-7. *L. maslinensis* sp. nov., Adelaide (Kent Town) Bore, Aldingan; (5) holotype, dorsal view (x2.2); (6) holotype, interior view (x2.2). Paratype (SAM P 18344), Maslin Bay; (7) dorsal view (x2.2).



FIGS 8–16

TABLE 1
Dimensions (in mm) and ratios of *Lima bassi*

Specimens	Ht	Lt	Lpa	Laa	Hr	Lr	Ts	Tca	Lca	Hca	â
Neotype	53.00	45.85	7.60	4.80	3.80	4.30	7.95	1.50	12.40	2.90	1°37′
Paraneotype 1	23.50	19.35	2.75	2.45	2.10	1.90	3.10	0.75	5.15	1.45	1°49′
Paraneotype 2	27.15	—	4.60	2.90	2.20	1.70	4.55	1.35	7.50	1.95	2°50′
Paraneotype 3	38.27	32.90	5.25	3.70	3.50	3.00	7.35	1.20	8.95	2.60	1°47′
Paraneotype 4	28.80	22.95	3.75	2.45	2.05	2.45	4.90	0.85	6.70	1.60	1°41′

Specimens	Lt/Ht	Laa/Lpa	Laa/Lca	Lpa/Lca	Lr/Hr	Ts/Lt	Ts/Ht	Tgâ = Tca/Ht	Hca/Lca
Neotype	.8659	.6316	.3879	.6129	1.1316	.1734	.1500	.02830	.2339
Paraneotype 1	.8234	.8910	.4785	.5371	.9048	.1602	.1319	.03191	.2832
Paraneotype 2	—	.6304	.3867	.6133	1.2941	—	.1676	.04972	.2600
Paraneotype 3	.8601	.7048	.4134	.5866	.8571	.2234	.1921	.03137	.2905
Paraneotype 4	.7969	.6533	.3657	.5597	1.1951	.2135	.1701	.02951	.2388

minifera. Hutton (1887) synonymized *L. bassi* with *L. colorata* Hutton, 1873 (Boreham 1965) because "Mr Woods' name stands as mine is incorrect". Later authors such as Suter (1914) accepted Hutton's name. Probably after Hutton, Tate (1899) quoted *L. bassi* occurring also in New Zealand. Finlay (1924) quoted *L. colorata* as one of the New Zealand species corresponding to *L. bassi*. However, an Awamoan senile specimen of *L. colorata* from Otago, in the Department of Geology and Mineralogy at the University of Adelaide, displays specific differences as trapezoidal-shaped broad radial ribs with broader interspaces, as only fine growth lines in juvenile stages and also radial oblique, very fine striations in adult and senile stages.

Lima maslinensis sp. nov.

FIGS 5–10

1886 *Lima bassi* var. *B* Tate, p. 117, pl. 8, fig. 1a–c.

Derivation of Name: From Maslin Bay, locality of the lowest recorded occurrence of this form.

Holotype: T983D, holotype of var. *B*, figs 5–6.

Paratypes: T983 A–C, E.

Type Locality: Old E & W. Dept Kent Town Bore, Hd Adelaide, sect. NE Parklands No. 13.

Stratigraphic Range: Aldingan (Late Eocene) (Ludbrook 1973).

Collections: SAM T983 A–E, P18344.

Material: 26 specimens (8 LV, 4 RV, 14 VV) badly preserved; 5 specimens from Tate's Collection (2RV, 3LV).

Description: As *L. bassi*. Differences: stronger teeth, the anteriors longer, the posterior triangular.

Ornament: Primary radial scaly costae with rectangular section and with equal U-shaped interspaces. In the interspaces, fine flat transverse microcostae in the anterior and posterior regions, convergent to the dorso-umbonal; in the dorsoventral region the microcostae overlap with a shagreen pattern. Anterior marginal region with numerous fainter radial spiny ribs.

Auricles: anterior with concentric costae; posterior with concentric costae and faint spiny radials.

Dimensions (mm):
T983 D—Ht, 37.5; Lt, 25.45; Lpa, 4.70; Laa, 3.55; Hr, 2.30; Lr, 2.90; Ts, 5.65; Tca, 1.45; Hca, 2.70; Lca, 8.25.

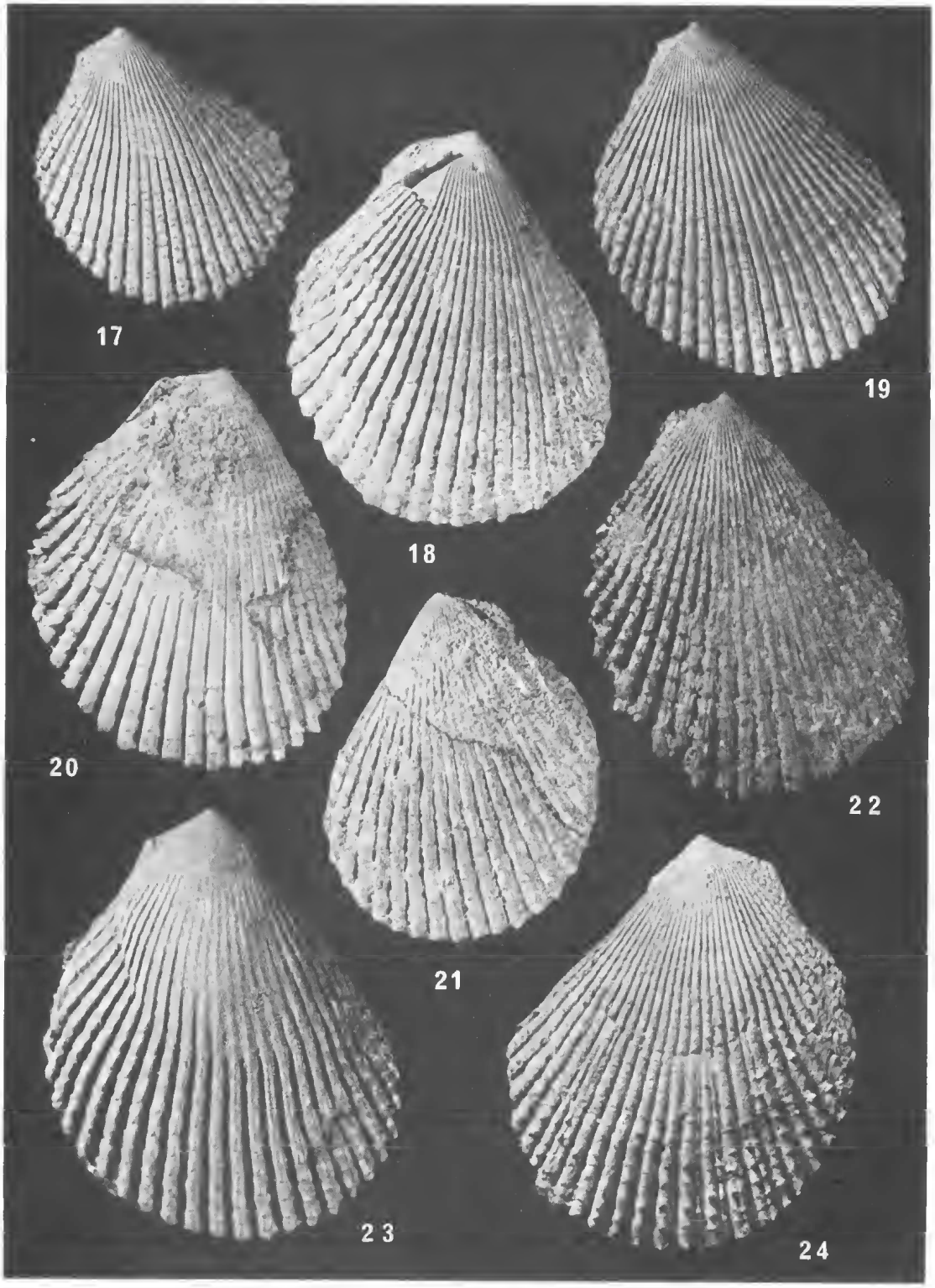
Ratios: T983 D—Lt/Ht, .6876; Laa/Lpa, .7553; Laa/Lca, .4303; Lpa/Lca, .5697; Lr/Hr, 1.2609; Ts/Lt, .2220; Ts/Ht, .1507; Tgâ = Tca/Ht, .03866; Hca/Lca, .3273.

Observations. Tate initially separated this form from *Lima bassi* Tenison Woods as var. *B*. Teeth, microcostal pattern, posterior auricle and anterior marginal ornaments distinguish this form at specific level from *L. bassi*.

Tate's holotype of the variety is here chosen as the holotype of *L. maslinensis*, although from it is the subsurface and broken into two neat pieces, it is the only well preserved specimen.

Distribution. St Vincent Basin: Adelaide Plains Sub-Basin, Kent Town Bore; Willunga Sub-Basin, Maslin Bay.

Figs 8-10. *L. maslinensis* sp. nov.: (8) anterior ventral ornament (x13); (9) posterior ventral ornaments (x12); (10) dorsoventral ornaments (x12). Figs 11-13. *Lima bassi*, paraneotype 8, Freestone Cove, ornament: (11) anterior ventral (x13); (12) dorsoventral (x13); (13) posterior ventral (x12). Figs 14-16. *Lima morganensis* sp. nov., holotype, ornaments: (14) dorsoventral (x10); (15) juvenile dorsoventral and posterior auricle (x9.5); (16) anterior ventral (x9.5).



FIGS 17–24

Lima morganensis sp. nov.

FIGS 3–4, 14–16

1886 *Lima bassii* var. *A* Tate, p. 117, pl. 5, fig. 8a–b. ?1897 *Lima bassii* Harris, p. 310 (*non* Tenison Woods).

Derivation of Name: From Morgan, the town nearby, after which Morgan Limestone was named.

Holotype: GSSA M3138, fig. 3.

Paratypes: T982 A–L, fig. 4.

Stratigraphic Location: Cadell Marls Lens (Batesfordian) (Ludbrook 1973).

Type-Locality: 6.4 km S of Morgan, type section of Cadell Marl, section G, Hd Cadell (Ludbrook 1961).

Material: 11 specimens from Tate's collection (7 RV, 4 LV); 1 RV from GSSA Collection (Holotype).

Description. As *L. bassi*.

Ornament: Primary radial subtriangular scaly ribs with equal V-shaped interspaces; long very inclined chevron-shaped microriblets covering ribs and interspaces, with their head on the ribs orientated to the umbo. Posterior auricle with more marked concentric costae and weak spiny radial ribs. Anterior auricle with concentric costae and weak beaded radial ribs.

Dimensions (mm):
T982 A—Ht, 32.20; Lt, 26.00; Lpa, 5.55; Laa, 3.85; Hr, —; Lr, —; Ts, 4.70; Tca, 1.35; Lca, 9.40; Hca, 2.10; $\hat{a}$, 1°24'. T982 E—Ht, 20.50; Lt, 15.25; Lpa, 3.60; Laa, 2.70; Hr, 2.20; Lr, 1.50; Ts, —; Tca, —; Lca, 6.30; Hca, 1.95; $\hat{a}$, —.

Ratios:
T982 A—Lt/Ht, .8074; Laa/Lpa, .6937; Laa/Lca, .4085; Lpa/Lca, .5904; Lr/Hr, —; Ts/Lt, .1808; Ts/Ht, .1460; $tg\hat{a}$ = Tca/Ht, .04192; Hca/Lca, .2234. T982 E—Lt/Ht, .7439; Laa/Lpa, .7500; Laa/Lca, .4286; Lpa/Lca, .5714; Lr/Hr, .6818; Ts/Lt, —; Ts/Ht, —; $tg\hat{a}$ = Tca/Ht, —; Hca/Lca, .3095.

Observations. Tate initially distinguished this form as a variety of *Lima bassi* Tenison Woods. Shape of the ribs and interspaces ornaments of posterior auricle, anterior marginal region and interspaces and radial costae separate this form from *L. bassi*.

The specimen T982 A is the holotype of Tate's var. *A*. The original illustration of Fig. 8a is inverted. The specimen from GSSA Collection was chosen as holotype because of its good topographic and stratigraphic location.

Lima elianae sp. nov.

FIGS 28–31

1955 *Lima bassi*—Ludbrook, p. 36 (pars).

Derivation of Name: After Dott. Eliana Garbarino (Mrs Buonaiuto), the author's mother.

Holotype: GSSA M 2384, figs 25–26.

Paratypes: GSSA M 158, figs 28–31; SAM P19210, Fig. 27.

Type-Locality: Observation Bore D, hd Port Adelaide, St Kilda, 81.38–83.5 m depth.

Type-Formation: Dry Creek Sands, Yatalan.

Material: The holotype (LV) and an adult (SAM P 19210) with damaged margins and a specimen (GSSA M 159) with the ventral part broken.

Description. As *L. bassi*.

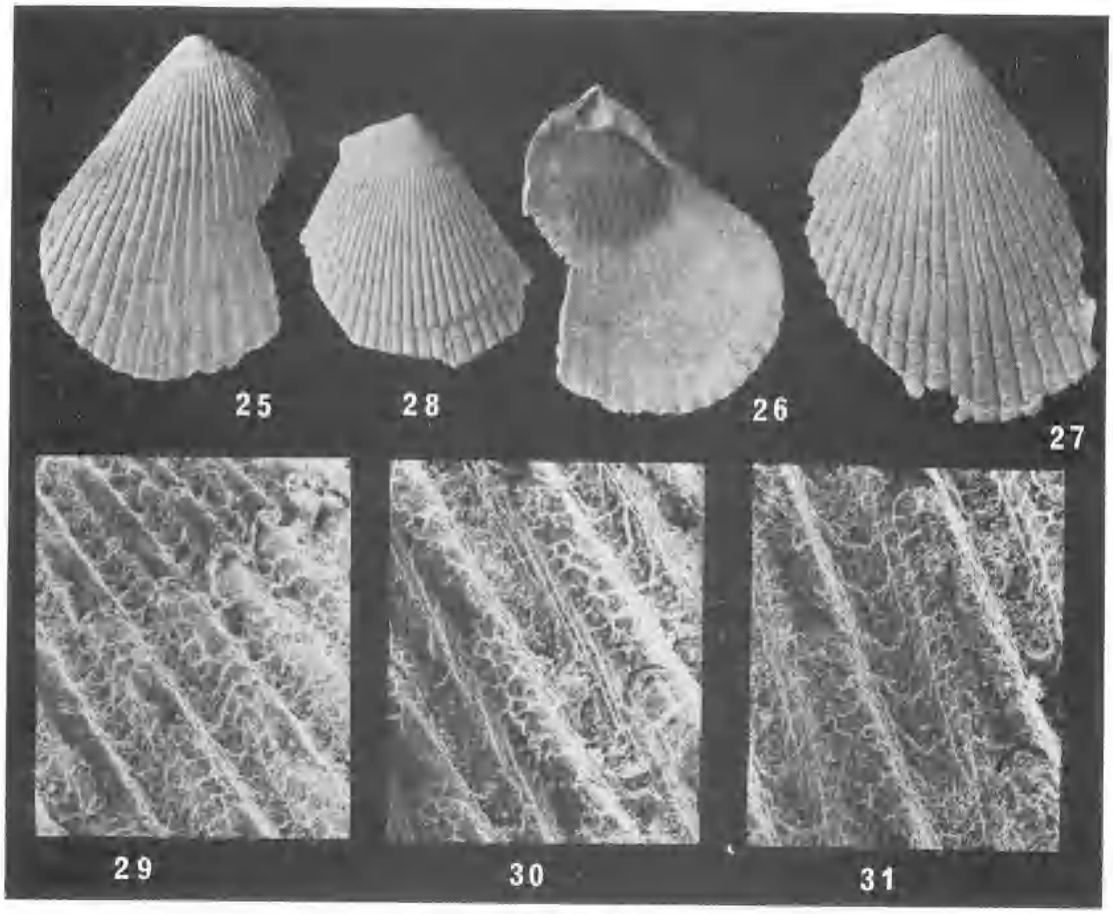
Ornament: Primary radial subquadrangular costae with equal U-shaped interspaces; in neanic stage prominent concentric microcostae. In the adult stage short chevron-shaped concentric microcostae with the head to the ventral in the interspaces; the V-microcostae can be substituted by narrow belts of normal concentric microcostae, meanwhile in the senile stage they are entirely substituted by fine growth rugae and fine radial oblique microplicae.

Observations. The specimen of *L. elianae* from Abattoirs Bore is that quoted by Woods (1931) as *Austrolima bassi*. The form referred by Tate (1890) to *L. bassi* from Dry Creek Bore is at present unlocated but almost certainly belongs to *L. elianae*.

Unfortunately the only three specimens available are both from bores and both damaged. The senile from Observation Bore is chosen as holotype because it is the only one with a sure stratigraphic location.

L. elianae, *L. bassi*, and *L. maslinensis* are all characterized by subquadrangular radial costae and chevron-shaped concentric microcostae. They might represent a lineage, but the material available is inadequate to be certain.

Figs 17-24. *Lima bassi*, paraneotypes, Freestone Cove; (17) Paraneotype 3 (x1.15); (18) Paraneotype 7 (x1.7); (19) Paraneotype 1 (x2.4); (20) Paraneotype 6 (x2.1); (21) Paraneotype 5 (x1.15); (22) Paraneotype 4 (x2.2); (23) Paraneotype 8 (x2.2); (24) Paraneotype 2 (x2.4).



FIGS 25–31

Figs 25-26. *Lima elianae* sp. nov., holotype: (GSSA M 2384), Observation Bore D, Late Pliocene, views (x1.0); (25) dorsal; (26) interior. Fig. 27. *Lima elianae* sp. nov. paratype (SAM P 19210), Abbattoirs Bore, Late Pliocene, dorsal view (x1.4). Figs 28-31. *Lima elianae* sp. nov., paratype (GSSA M 159), Munno Para Bore, Late Pliocene; (28) dorsal view (x1.95). Ornament: (29) dorsal juvenile transitional to adult; (30) dorsal, adult; (31) anterior, adult.

Other Localities: Adelaide Plains Sub-Basin. Abattoirs Bore; bore hd. Munno Para, Sect. 4251, 72.5–78.0 m depth.

Stratigraphic Range: Yatalan (Late Pliocene).

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